Blueshift - June 30, 2009

[Intro music]

Sara Mitchell: Welcome to the June 30th 2009 episode of Blueshift, brought to you from NASA's Goddard Space Flight Center. For the second episode in our summer series about data, Eric Winter got the scoop on how data gets from the satellite to you.

[music]

Eric Winter: The Fermi mission launched into orbit June 11th, 2008, from Cape Canaveral, Florida. First, the team checked out Fermi's systems and its two instruments. Then the spacecraft began streaming data to eager scientists on the ground. But, as the saying goes, getting there is half the fun.

[music]

Dave Thomspon: Hi, I'm Dave Thompson, a Deputy Project Scientist for the Fermi mission at NASA's Goddard Space Flight Center. The Fermi satellite carries two instruments - the Large Area Telescope, or LAT, and the Gamma-ray Burst Monitor, or GBM. These instruments convert the gamma rays to electrical signals, which are then converted by the spacecraft computers into digital data. These data are then transmitted to the T D R S S (TDRSS) satellites during regularly-scheduled data links several times a day.

[music]

Eric: TDRSS isn't the name of an elven princess - it's an acronym for the Tracking and Data Relay Satellite System. NASA and other government agencies use the nine TDRSS satellites like a telephone switching center that channels messages from the Space Shuttle, the Space Station, and data-producing satellites like Fermi. The data streams from the TDRSS satellites all go to a ground station in White Sands, New Mexico. There the data is sorted and sent to the appropriate destination. For Fermi data, the next stop is the Mission Operations Center, or MOC, here at NASA's Goddard Space Flight Center in Greenbelt, Maryland. At the MOC, the data undergo quick initial quality checks and archiving. When the MOC finishes with the raw data, it sends it out to the instrument teams. There's one team for each instrument.

[music]

Rob Cameron: I'm Rob Cameron, the manager of the LAT Instrument Science Operations Center, or LISOC, at the SLAC National Accelerator Lab at Stanford University in California. Several times a day, the LISOC receives a few hours of LAT data. These data deliveries arrive day and night, seven days a week, so basic LAT data processing at SLAC is automated. Hundreds

of computers at SLAC are used to process the data. Why so many computers? While the LAT detects only about one gamma ray photon per second from the universe, thousands of charged subatomic particles per second are also hitting the LAT. Ground data processing performs detailed analysis of each LAT event readout, to separate the gamma ray photons from the much higher background rate of charged particles. They measure direction, time, and energy of the observed gamma ray photons, and then transmit it back to NASA from SLAC, only hours after being detected by the LAT. The LAT can detect bright gamma ray bursts lasting only seconds and can then automatically send information on a detected burst to the ground within seconds. Also, each day, data processing at SLAC searches the entire sky for bright, varying gamma ray sources, and delivers data on them to NASA.

[music]

Valerie Connaughton: I'm Valerie Connaughton, a research scientist at the GBM Instrument Operations Center, or GIOC, in Huntsville, Alabama. Here at the GIOC we receive two different types of data. One is the regularly downlinked variety. The other is the so-called Alert Telemetry. GBM enters a special alert mode when a burst of gamma rays causes it to trigger. Within five seconds of a trigger, a special TDRSS contact is established that can transmit to the ground in real time limited information within about ten seconds of its occurrence. The information is processed and transferred automatically by computers at the GIOC to the Gamma ray burst Coordinates Network (or GCN), computers at the GSFC, and from there to observers around the world. Human operators are also paged by the GIOC computers to kick off manual processing that will allow communication of updated information via email to the GCN. An hour or three later, the full telemetry will arrive at the GIOC on a scheduled contact, and will be processed automatically by GIOC computers for transfer to the Fermi Science Support Center.

[music]

Eric: There, the data undergo any final processing and quality checks, and are stored in a database for access by Fermi science team members.

[music]

John Vernaleo: Hi, I'm John Vernaleo. I work for the Fermi Science Support Center at NASA Goddard. We provide data from the Fermi gamma ray telescope to the scientific public, and we put it into our server where we provide ways for scientists to search the data, and this division is nice because the instrument people, the people who understand the instruments the most, can focus on getting the data reconstructed the best, and then they can leave it to us to focus on letting the scientists search the data.

[music]

Eric: That's how I get Fermi data onto my laptop. But that's not the end of the line. Eventually, all of that data must be released to the general scientific community. For Fermi, some data, such as light curves for flaring sources and the locations of gamma-ray bursts, are made public immediately.

Not all of it, though. Like many missions, the Fermi team has proprietary access to the data for a limited time. This ensures that the first Fermi data products are processed by those who know the instruments best. After the first year of operations, all of the data from both instruments will become public the moment they hit the ground. This will allow the entire scientific community -- and even ambitious amateur scientists -- to look at the astronomical data fresh from the source.

[music]

Sara: To learn more about Fermi data, and all those steps between the satellite and your computer, check out our website at: universe.nasa.gov/blueshift

You can also follow us on Twitter as nasablueshift. Stay tuned for more episodes in our summer series about data. We'll be back, bringing the Universe closer to you with Blueshift.

[music]